

Forsmark site investigation

**Laboratory data from the site
investigation programme for the
transport properties of the rock**

Data delivery for data freeze Forsmark 2.1

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October 2005

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This report concerns a study which was conducted for SKB. The conclusions and viewpoints presented in the report are those of the authors and do not necessarily coincide with those of the client.

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Abstract

This report presents data gained from laboratory investigations of diffusivity and sorption characteristics at the time for data freeze Forsmark 2.1. Boreholes concerned in the investigation are: KFM01A, KFM01B, KFM02A, KFM03A, KFM04A, KFM05A, KFM06A, KFM06B and KFM07A. Discussions and interpretations of the results are not included in the present report. The laboratory investigations are part of the discipline-specific programme “Transport Properties of the Rock” within the SKB site investigations.

Since diffusivity and sorption measurements are still in progress, only matrix porosity data and data from concluded through-diffusion measurements retrieved hitherto are presented.

Sammanfattning

Föreliggande rapport redovisar de resultat som erhållits från laboratoriemätningar av diffusions- och sorptionsegenskaper vid tidpunkten för datafrys Forsmark 2.1. Borrhålsdata från följande borrhål presenteras i rapporten: KFM01A, KFM01B, KFM02A, KFM03A, KFM04A, KFM05A, KFM06A, KFM06B and KFM07A. Rapporten redovisar inga diskussioner eller tolkningar av resultat. Mätning av nämnda egenskaper ingår i programmet för "Bergets transportegenskaper" inom SKB:s platsundersökningar. Då mätningar av genomdiffusion och batchsorption är tidskrävande och ännu pågår, redovisas endast porositetsvärden samt data från avslutade genomdiffusionsmätningar.

Contents

1	Introduction	7
2	Objective and scope	9
3	Laboratory measurements	11
3.1	General	11
3.2	Matrix porosity	11
3.3	Through-diffusion measurements	11
4	Results	13
4.1	General	13
4.2	Matrix porosity	13
4.3	Through-diffusion measurements	13
4.4	Nonconformities	14
	References	15
	Appendix 1 Matrix porosity	17
	Appendix 2 Effective diffusivity and rock capacity factor	23

1 Introduction

The report contains data gained from the laboratory investigations of diffusivity and sorption characteristics within the discipline-specific programme “Transport Properties of the Rock” which is one of the activities performed within the site investigation at Forsmark. The work was carried out during the period from April 2004 to June 2005, in accordance with activity plan AP PF 400-03-58. In Table 1-1 controlling documents for performing this activity are listed. Both activity plan and method descriptions are SKB’s internal controlling documents.

The rock samples for the laboratory measurements were collected from the core drilled boreholes KFM01A, KFM01B, KFM02A, KFM03A, KFM03B, KFM04A, KFM05A, KFM06A and KFM07A by Eva Gustavsson and Henrik Widestrand, Geosigma AB.

Data presented in this report have been delivered to SICADA according to AP PF 400-03-58 and are traceable by the Activity Plan number. The locations of the boreholes are presented in Figure 1-1 below.

Table 1-1. Controlling documents for performance of the activity.

Activity plan	Number	Version
Provtagning och analyser av borrhärlar från kärnborrhål KFM01A–KFM07A för bestämning av bergets transportegenskaper	AP PF 400-03-58	1.0
Method descriptions	Number	Version
Metodbeskrivning för geomdiffusionsmätning	SKB MD 540.001	1.0
Metodbeskrivning för batchsorptionsmätning	SKB MD 540.002	2.0

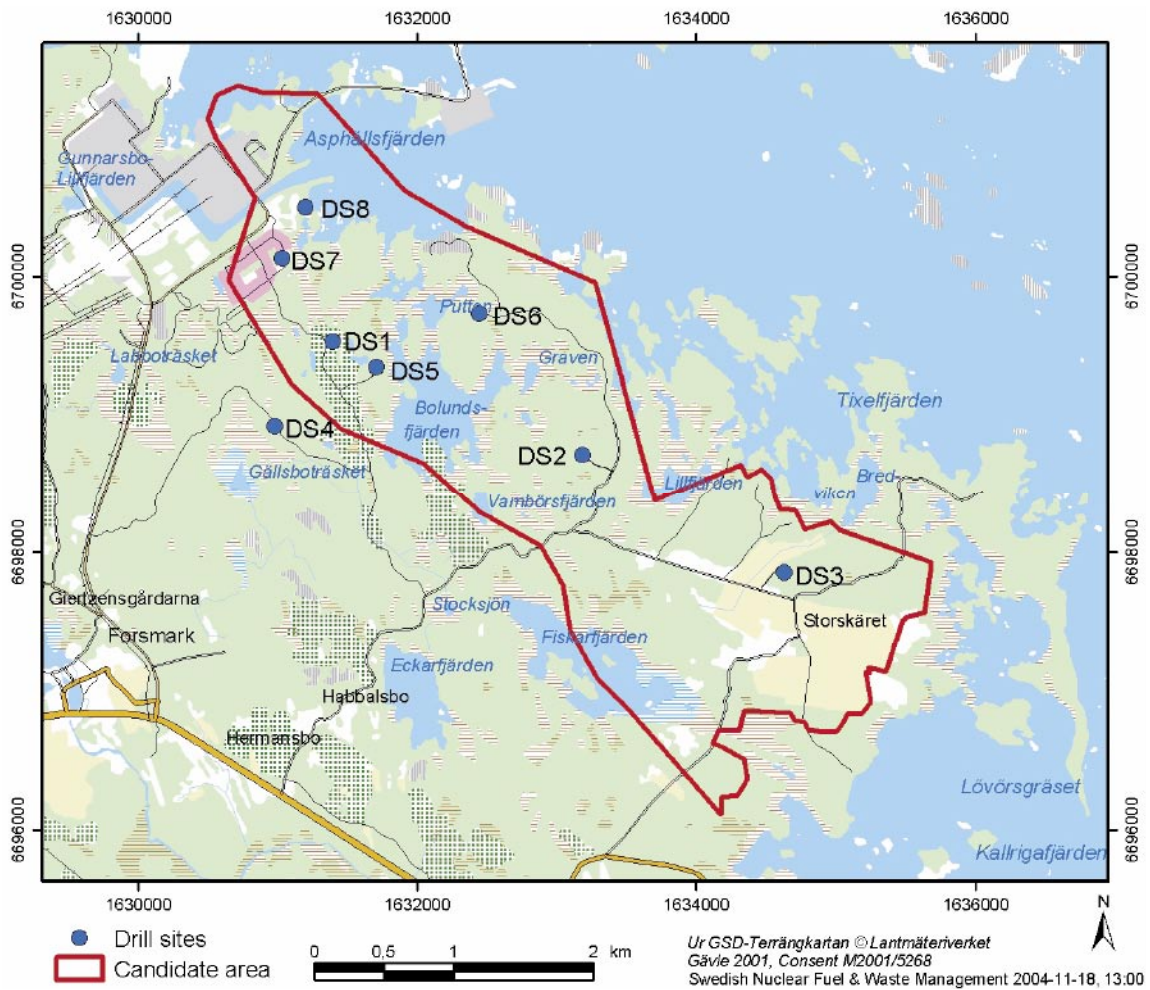


Figure 1-1. The investigation area at Forsmark (approximately the area inside the black square) including the candidate area selected for more detailed investigations. The eight drill sites (DS1-8) for deep boreholes are marked with blue circles. Boreholes KFM01A-KFM07A are located at drill sites DS1- DS7, respectively.

2 Objective and scope

The main aim with the laboratory investigations performed is to determine the sorption and diffusion properties for the rock materials found in the candidate area in Forsmark.

Laboratory measurements on rock samples and drill cores provide direct information on the retardation properties of the rock matrix and the fracture materials. The parameters that are determined are:

- matrix porosity (defined as open porosity in SS-EN 1936),
- porosity distribution,
- diffusivity of the rock materials,
- sorption coefficients for a number of combinations of rock materials, radio nuclides and groundwater compositions.

The measurements are performed on rock cores or crushed rock from several different parts of the candidate rock volume. Features as major and minor rock types, different fracture types and fracture zones at the Forsmark area are represented in the total sample collection.

About 330 rock samples are included in the laboratory investigations, but as sorption and diffusivity measurements are time-consuming and still on-going experiments, there are only a small number of diffusivity data in addition to matrix porosity data from KFM01A, KFM01B, KFM02A, KFM03A, KFM03B, KFM04A, KFM05A, KFM06A and KFM07A that are reported in this document. Results from sorption measurements have not yet been obtained. Electrical resistivity data, for calculating the formation factor and the effective diffusivity, are presented in two separate reports /Thunehed, 2005a,b/. Laboratory measurements of ¹⁴C- PMMA (porosity distribution) are still in progress.

Brief descriptions of the laboratory methods, relevant for the data presentation in this document, are given in Chapter 3. Strategy for the use of laboratory methods can be found in a separate report /Byegård et al. 2003/. Matrix porosity data tables and data from through-diffusion measurements are presented in Appendices 1 and 2.

As much of the laboratory works still are in progress, there are no discussions or interpretations of the results included in this report. A final report will be produced during 2006.

3 Laboratory measurements

3.1 General

Sample preparation and water porosity measurements have been made at the Swedish National Testing and Research Institute (SP). Through-diffusion measurements are performed at Chalmers University of Technology (CTH).

3.2 Matrix porosity

194 drill core samples from the Forsmark area were sent to SP (Swedish National Testing and Research Institute) for matrix porosity measurements. The length of the samples varies from 0.5 to 5 cm, but the majority are 3 cm long. The diameter of the core samples is 5.0 cm. Information of the porosity is produced in the laboratory measurements as supporting data in the diffusion experiments. The porosity of the rock matrix can be determined in several different ways by means of laboratory measurements on slices of drill cores. The most common method and the method used in this investigation, is the water saturation technique which is determined according to standard methods /SS-EN 1936/.

3.3 Through-diffusion measurements

Matrix diffusivity measurements are carried out by measuring how quickly an added substance diffuses through a piece of a drill core, so-called through-diffusion measurements /Ohlsson and Neretnieks, 1995; Byegård et al. 1998/. The measurement is normally performed on a 1–5 cm thick sawn-out slice of a drill core placed in a measurement cell. One side of the core piece is in contact with a synthetic groundwater and the other is in contact with a synthetic groundwater tagged with the radionuclide to be studied (in this case tritiated water, HTO). Samples are then taken on the un-tagged side, and the effective diffusion coefficient, D_e , for the rock matrix can be calculated based on the concentration increase on the un-tagged side.

A more detailed description of through-diffusion experiments can be found in SKB MD 540.001 SKB internal document.

4 Results

4.1 General

The obtained results are stored in SICADA, according to AP PF 400-03-58. Discussions of the results and evaluation of the methods are left for the future when the final results will be reported.

4.2 Matrix porosity

Data gained from the laboratory measurements are presented in Appendix 1.

The uncertainty of a single reported porosity value is 0.09%, given with a coverage factor of 2.

4.3 Through-diffusion measurements

The obtained effective diffusivities are presented in Appendix 2.

The data are presented as a scaled accumulated amount of tracer in the target cell C_r as a function of time. The effective diffusivity D_e and the rock capacity factor α were fitted to the experimental data using Equation 1:

$$C_r = \frac{D_e t}{l^2} - \frac{\alpha}{6} - \frac{2\alpha}{\pi^2} \sum_{n=1}^{\infty} \frac{(-1)^n}{n^2} \exp\left\{-\frac{D_e n^2 \pi^2 t}{l^2 \alpha}\right\}, \quad (1)$$

where t is the experimental time after injection of tracer, l is the length of the rock sample and n is the summation factor.

The latter part of the experimental data is also fitted to a simplified linear form of Equation 1, *i.e.*

$$C_r = \frac{D_e t}{l^2} - \frac{\alpha}{6}. \quad (2)$$

In Figure 4-1 an example of experimental through-diffusion data is presented together with the result from successful model calculations using Equation 1.

The discussion of the results as well as an evaluation of the method and the diffusion model are left for the future when final results will be reported.

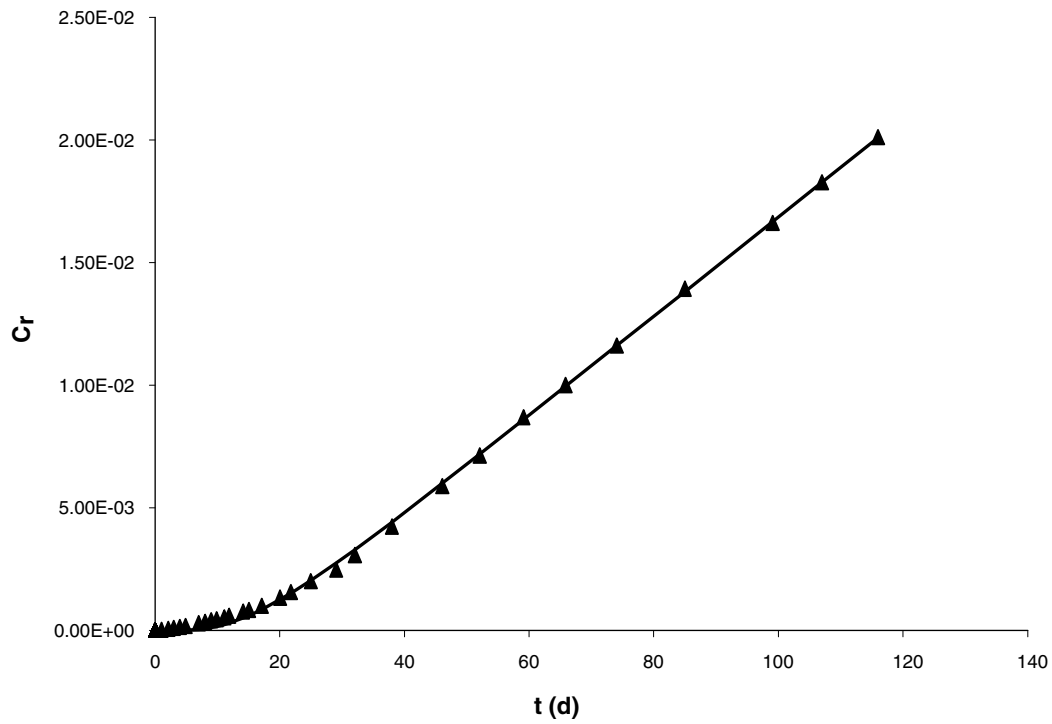


Figure 4-1. Preliminary data of measured C_r values (\blacktriangle) as a function of time from a HTO through-diffusion experiment on a 1.0 cm thick sample from KFM02A (KFM02A-554.71–554.72). The solid line represents calculated C_r values using Equation 1 with D_e and α optimized for a fit to the experimental data.

4.4 Nonconformities

None.

References

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SS-EN 1936:1999E. Natural stone test method. Determination of read density and apparent density, and of total and open porosity. Swedish Standards Institute, Stockholm.

Matrix porosity

Appendix 1 contains matrix porosity data presented per drill-site.

Table A1-1.

Idcode	Secup	Seclow	Rock type	Rock code	Matrix porosity
KFM01B	23.92	23.95	Granite to granodiorite, metamorphic, medium-grained	101057	0.19
KFM01B	23.95	23.98	Granite to granodiorite, metamorphic, medium-grained	101057	0.19
KFM01B	23.98	24.01	Granite to granodiorite, metamorphic, medium-grained	101057	0.19
KFM01A	101.49	101.52	Granite to granodiorite, metamorphic, medium-grained	101057	0.17
KFM01A	119.99	120.02	Granite to granodiorite, metamorphic, medium-grained	101057	0.16
KFM01A	140.01	140.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.86
KFM01A	159.81	159.84	Granite to granodiorite, metamorphic, medium-grained	101057	0.15
KFM01A	199.96	199.99	Amphibolite	102017	0.08
KFM01A	240.01	240.04	Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained	101051	0.25
KFM01A	259.91	259.94	Granite to granodiorite, metamorphic, medium-grained	101057	0.26
KFM01A	300.01	300.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.15
KFM01A	312.53	312.54	Granite to granodiorite, metamorphic, medium-grained	101057	0.19
KFM01A	312.54	312.55	Granite to granodiorite, metamorphic, medium-grained	101057	0.20
KFM01A	312.56	312.59	Granite to granodiorite, metamorphic, medium-grained	101057	0.16
KFM01A	312.59	312.64	Granite to granodiorite, metamorphic, medium-grained	101057	0.17
KFM01A	312.65	312.66	Granite to granodiorite, metamorphic, medium-grained	101057	0.19
KFM01A	312.66	312.67	Granite to granodiorite, metamorphic, medium-grained	101057	0.19
KFM01A	312.68	312.71	Granite to granodiorite, metamorphic, medium-grained	101057	0.16
KFM01A	312.71	312.76	Granite to granodiorite, metamorphic, medium-grained	101057	0.18
KFM01A	312.76	312.77	Granite to granodiorite, metamorphic, medium-grained	101057	0.39
KFM01A	312.77	312.78	Granite to granodiorite, metamorphic, medium-grained	101057	0.15
KFM01A	312.78	312.81	Granite to granodiorite, metamorphic, medium-grained	101057	0.03
KFM01A	312.81	312.86	Granite to granodiorite, metamorphic, medium-grained	101057	0.13
KFM01A	320.01	320.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.13
KFM01A	340.01	340.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.13
KFM01A	360.01	360.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.16
KFM01A	380.01	380.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.12
KFM01A	420.01	420.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.17
KFM01A	440.01	440.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.18
KFM01A	460.01	460.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.17
KFM01A	480.01	480.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.20
KFM01A	501.73	501.76	Granite to granodiorite, metamorphic, medium-grained	101057	0.20
KFM01A	520.01	520.04	Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained	101051	0.13

Idcode	Secup	Seclow	Rock type	Rock code	Matrix porosity
KFM01A	539.99	540.02	Granite to granodiorite, metamorphic, medium-grained	101057	0.12
KFM01A	560.01	560.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.18
KFM01A	580.01	580.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.18
KFM01A	600.01	600.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.23
KFM01A	620.01	620.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.18
KFM01A	640.06	640.09	Granite to granodiorite, metamorphic, medium-grained	101057	0.13
KFM01A	659.86	659.89	Granite to granodiorite, metamorphic, medium-grained	101057	0.22
KFM01A	680.01	680.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.21
KFM01A	699.96	699.99	Granite to granodiorite, metamorphic, medium-grained	101057	0.23
KFM01A	719.96	719.99	Granite to granodiorite, metamorphic, medium-grained	101057	0.22
KFM01A	740.01	740.04	Amphibolite	102017	0.22
KFM01A	760.01	760.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.22
KFM01A	780.01	780.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.24
KFM01A	800.01	800.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.32
KFM01A	820.01	820.04	Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained	101051	0.28
KFM01A	840.17	840.2	Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained	101051	0.10
KFM01A	860.01	860.04	Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained	101051	0.16
KFM01A	880.01	880.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.20
KFM01A	900.01	900.04	Pegmatite, pegmatitic granite	101061	0.27
KFM01A	920.01	920.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.25
KFM01A	940.06	940.09	Granite to granodiorite, metamorphic, medium-grained	101057	0.33
KFM01A	960.01	960.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.24
KFM01A	980.01	980.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.23
KFM01A	999.96	999.99	Granite to granodiorite, metamorphic, medium-grained	101057	0.24

Table A1-2.

Idcode	Secup	Seclow	Rock type	Rock code	Matrix porosity
KFM02A	101.01	101.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.20
KFM02A	121.01	121.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.36
KFM02A	141.01	141.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.15
KFM02A	161.01	161.04	Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained	101051	0.21
KFM02A	181.01	181.04	Amphibolite	102017	0.34
KFM02A	201.01	201.04	Amphibolite	102017	0.10
KFM02A	221.01	221.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.25
KFM02A	241.01	241.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.18
KFM02A	261.01	261.04	Granite to granodiorite, metamorphic, medium-grained	101057	2.18
KFM02A	275.93	275.94	Granite to granodiorite, metamorphic, medium-grained	101057	9.36
KFM02A	275.94	275.95	Granite to granodiorite, metamorphic, medium-grained	101057	16.32
KFM02A	275.95	275.98	Granite to granodiorite, metamorphic, medium-grained	101057	17.22

Idcode	Secup	Seclow	Rock type	Rock code	Matrix porosity
KFM02A	275.99	276.04	Granite to granodiorite, metamorphic, medium-grained	101057	17.94
KFM02A	276.04	276.05	Granite to granodiorite, metamorphic, medium-grained	101057	10.45
KFM02A	276.05	276.06	Granite to granodiorite, metamorphic, medium-grained	101057	16.25
KFM02A	276.06	276.09	Granite to granodiorite, metamorphic, medium-grained	101057	18.42
KFM02A	276.1	276.15	Granite to granodiorite, metamorphic, medium-grained	101057	18.52
KFM02A	276.15	276.16	Granite to granodiorite, metamorphic, medium-grained	101057	11.54
KFM02A	276.16	276.17	Granite to granodiorite, metamorphic, medium-grained	101057	16.84
KFM02A	276.17	276.2	Granite to granodiorite, metamorphic, medium-grained	101057	19.33
KFM02A	276.2	276.25	Granite to granodiorite, metamorphic, medium-grained	101057	19.09
KFM02A	281.01	281.04	Granite to granodiorite, metamorphic, medium-grained	101057	11.05
KFM02A	300.96	300.99	Granite to granodiorite, metamorphic, medium-grained	101057	1.21
KFM02A	321.01	321.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.23
KFM02A	361.01	361.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.23
KFM02A	381.01	381.04	Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained	101051	0.23
KFM02A	401.01	401.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.29
KFM02A	420.93	420.96	Granite to granodiorite, metamorphic, medium-grained	101057	0.40
KFM02A	440.96	440.99	Granite to granodiorite, metamorphic, medium-grained	101057	0.18
KFM02A	460.96	460.99	Granite to granodiorite, metamorphic, medium-grained	101057	0.38
KFM02A	481.01	481.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.17
KFM02A	500.68	500.71	Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained	101051	0.42
KFM02A	521.01	521.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.20
KFM02A	541.01	541.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.25
KFM02A	554.59	554.6	Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained	101051	0.54
KFM02A	554.6	554.61	Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained	101051	0.31
KFM02A	554.61	554.64	Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained	101051	0.23
KFM02A	554.65	554.7	Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained	101051	0.22
KFM02A	554.7	554.71	Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained	101051	0.34
KFM02A	554.71	554.72	Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained	101051	0.21
KFM02A	554.72	554.75	Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained	101051	0.22
KFM02A	554.76	554.81	Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained	101051	0.23
KFM02A	554.81	554.82	Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained	101051	0.37
KFM02A	554.84	554.85	Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained	101051	0.26
KFM02A	554.86	554.89	Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained	101051	0.23
KFM02A	554.9	554.95	Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained	101051	0.24

Idcode	Secup	Seclow	Rock type	Rock code	Matrix porosity
KFM02A	561.01	561.04	Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained	101051	0.19
KFM02A	580.89	580.92	Granite to granodiorite, metamorphic, medium-grained	101057	0.15
KFM02A	601.01	601.04	Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained	101051	0.21
KFM02A	620.96	620.99	Granite to granodiorite, metamorphic, medium-grained	101057	0.21
KFM02A	641.01	641.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.28
KFM02A	661.01	661.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.22
KFM02A	681.01	681.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.19
KFM02A	701.01	701.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.25
KFM02A	721.01	721.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.22
KFM02A	741.01	741.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.20
KFM02A	761.01	761.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.22
KFM02A	781.01	781.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.23
KFM02A	801.01	801.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.27
KFM02A	821.01	821.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.24
KFM02A	841.01	841.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.27
KFM02A	861.01	861.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.30
KFM02A	881.01	881.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.25
KFM02A	901.01	901.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.22
KFM02A	921.01	921.04	Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained	101051	0.15
KFM02A	941.01	941.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.23
KFM02A	961.01	961.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.27
KFM02A	981.04	981.07	Granite to granodiorite, metamorphic, medium-grained	101057	0.24
KFM02A	1001.01	1001.04	Granite to granodiorite, metamorphic, medium-grained	101057	0.25

Table A1-3.

Idcode	Secup	Seclow	Rock type	Rock code	Matrix porosity
KFM03A	76.74	76.77	Pegmatite, pegmatitic granite	101061	0.24
KFM03A	242.43	242.46	Tonalite to granodiorite, metamorphic	101054	0.19
KFM03A	242.46	242.49	Tonalite to granodiorite, metamorphic	101054	0.15
KFM03A	242.49	242.52	Tonalite to granodiorite, metamorphic	101054	0.17
KFM03A	311.45	311.48	Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained	101051	0.15
KFM03A	367.44	367.47	Pegmatite, pegmatitic granite	101061	0.32
KFM03A	660.41	660.44	Pegmatite, pegmatitic granite	101061	0.68
KFM03A	957.67	957.70	Granite to granodiorite, metamorphic, medium-grained	101057	0.13

Table A1-4.

Idcode	Secup	Seclow	Rock type	Rock code	Matrix porosity
KFM04A	120.04	120.07	Granodiorite, metamorphic	101056	0.48
KFM04A	140.03	140.06	Granodiorite, metamorphic	101056	0.19
KFM04A	180.02	180.05	Granite to granodiorite, metamorphic, medium-grained	101057	0.31
KFM04A	199.93	199.96	Granite to granodiorite, metamorphic, medium-grained	101057	0.21
KFM04A	220.00	220.03	Granite to granodiorite, metamorphic, medium-grained	101057	0.51
KFM04A	239.70	239.73	Amphibolite	102017	9.95
KFM04A	260.00	260.03	Granite to granodiorite, metamorphic, medium-grained	101057	0.89
KFM04A	300.04	300.07	Granite to granodiorite, metamorphic, medium-grained	101057	0.21
KFM04A	319.09	319.12	Granite to granodiorite, metamorphic, medium-grained	101057	0.72
KFM04A	339.83	339.86	Felsic to intermediate volcanic rock, metamorphic	103076	0.78
KFM04A	359.18	359.21	Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained	101051	0.59
KFM04A	379.95	379.98	Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained	101051	0.20
KFM04A	401.10	401.13	Granite to granodiorite, metamorphic, medium-grained	101057	0.22
KFM04A	420.19	420.22	Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained	101051	1.60
KFM04A	459.93	459.96	Granite to granodiorite, metamorphic, medium-grained	101057	0.31
KFM04A	479.93	479.96	Granite to granodiorite, metamorphic, medium-grained	101057	0.12
KFM04A	499.91	499.94	Granite to granodiorite, metamorphic, medium-grained	101057	0.17

Table A1-5.

Idcode	Secup	Seclow	Rock type	Rock code	Matrix porosity
KFM05A	168.34	168.37	Granite to granodiorite, metamorphic, medium-grained	101057	0.15
KFM05A	188.03	188.06	Granite to granodiorite, metamorphic, medium-grained	101057	0.59
KFM05A	208.82	208.85	Granite to granodiorite, metamorphic, medium-grained	101057	0.20
KFM05A	228.13	228.16	Granite to granodiorite, metamorphic, medium-grained	101057	0.18
KFM05A	249.03	249.06	Granite to granodiorite, metamorphic, medium-grained	101057	0.33
KFM05A	269.66	269.69	Granite to granodiorite, metamorphic, medium-grained	101057	0.24
KFM05A	288.85	288.88	Granite to granodiorite, metamorphic, medium-grained	101057	0.24
KFM05A	308.55	308.58	Granite to granodiorite, metamorphic, medium-grained	101057	0.22
KFM05A	348.25	348.28	Granite to granodiorite, metamorphic, medium-grained	101057	0.23
KFM05A	369.23	369.26	Granite to granodiorite, metamorphic, medium-grained	101057	0.18
KFM05A	388.93	388.96	Granite to granodiorite, metamorphic, medium-grained	101057	0.17
KFM05A	396.59	396.62	Granite to granodiorite, metamorphic, medium-grained	101057	0.48
KFM05A	396.62	396.65	Granite to granodiorite, metamorphic, medium-grained	101057	0.58
KFM05A	396.65	396.68	Granite to granodiorite, metamorphic, medium-grained	101057	0.54
KFM05A	408.75	408.78	Granite to granodiorite, metamorphic, medium-grained	101057	0.18
KFM05A	428.92	428.95	Granite to granodiorite, metamorphic, medium-grained	101057	0.24
KFM05A	449.35	449.38	Granite to granodiorite, metamorphic, medium-grained	101057	0.22
KFM05A	469.83	469.86	Granite to granodiorite, metamorphic, medium-grained	101057	0.22
KFM05A	489.36	489.39	Granite to granodiorite, metamorphic, medium-grained	101057	0.25
KFM05A	509.07	509.10	Granite to granodiorite, metamorphic, medium-grained	101057	0.30

Idcode	Secup	Seclow	Rock type	Rock code	Matrix porosity
KFM05A	528.72	528.75	Granite to granodiorite, metamorphic, medium-grained	101057	0.18
KFM05A	548.54	548.57	Granite to granodiorite, metamorphic, medium-grained	101057	0.22
KFM05A	570.04	570.07	Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained	101051	0.20
KFM05A	590.05	590.08	Granite to granodiorite, metamorphic, medium-grained	101057	0.30
KFM05A	629.30	629.33	Granite to granodiorite, metamorphic, medium-grained	101057	0.29
KFM05A	650.42	650.45	Granite to granodiorite, metamorphic, medium-grained	101057	0.17
KFM05A	669.90	669.93	Amphibolite	102017	0.30
KFM05A	689.69	689.72	Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained	101051	0.13
KFM05A	700.28	700.31	Granite, granodiorite and tonalite, metamorphic, fine- to medium-grained	101051	0.35
KFM05A	739.82	739.85	Granite to granodiorite, metamorphic, medium-grained	101057	0.34
KFM05A	761.07	761.10	Granite to granodiorite, metamorphic, medium-grained	101057	0.20

Table A1-6.

Idcode	Secup	Seclow	Rock type	Rock code	Matrix porosity
KFM06B	56.37	56.40	Granite to granodiorite, metamorphic, medium-grained	101057	9.13
KFM06B	56.40	56.43	Granite to granodiorite, metamorphic, medium-grained	101057	9.19
KFM06A	210.13	210.16	Granite to granodiorite, metamorphic, medium-grained	101057	0.25
KFM06A	210.16	210.19	Granite to granodiorite, metamorphic, medium-grained	101057	0.20
KFM06A	210.19	210.22	Granite to granodiorite, metamorphic, medium-grained	101057	0.20
KFM06A	331.72	331.75	Granite to granodiorite, metamorphic, medium-grained	101057	2.36
KFM06A	331.75	331.78	Granite to granodiorite, metamorphic, medium-grained	101057	2.49
KFM06A	331.78	331.81	Granite to granodiorite, metamorphic, medium-grained	101057	2.54
KFM06A	779.40	779.43	Granite, metamorphic, aplitic	101058	0.18

Table A1-7.

Idcode	Secup	Seclow	Rock type	Rock code	Matrix porosity
KFM07A	608.72	608.75	Granite to granodiorite, metamorphic, medium-grained	101057	0.27
KFM07A	608.75	608.78	Granite to granodiorite, metamorphic, medium-grained	101057	0.29
KFM07A	608.78	608.81	Granite to granodiorite, metamorphic, medium-grained	101057	0.29

Appendix 2

Effective diffusivity and rock capacity factor

Appendix 2 contains results from through-diffusion experiments of rock samples from KFM01A and KFM02A. D_e , the effective diffusivity and α , the rock capacity factor were obtained from least square fits of experimental data to Equation 1 and Equation 2 (the linear form).

SKB ID	Sample Thickness (mm)	D_e from Equation 1 (m ² /s)	D_e from Equation 2 (m ² /s)	α from Equation 1	α from Equation 2
KFM01A-281.00–281.05	30	1.30E–11	1.20E–11	6.20E–02	5.80E–02
KFM01A-312.54–312.55	10	2.00E–13	2.10E–13	9.60E–03	1.40E–02
KFM01A-312.66–312.67	10	3.00E–13	3.10E–13	1.50E–02	2.30E–02
KFM01A-312.68–312.71	30	3.10E–13	3.10E–13	5.00E–03	5.10E–03
KFM01A-312.77–312.78	10	3.20E–13	3.30E–13	1.80E–02	2.20E–02
KFM01A-539.98–540.03	30	1.70E–13	1.80E–13	1.70E–03	2.00E+03
KFM01A-554.60–554.61	10	3.80E–13	3.80E–13	2.00E–02	2.10E–02
KFM01A-554.71–554.72	10	3.20E–13	3.20E–13	2.00E–02	2.10E–02
KFM01A-554.84–554.85	10	3.00E–13	3.00E–13	2.10E–02	2.40E–02
KFM01A-999.95–1000.00	30	9.20E–13	9.30E–13	8.80E–13	9.40E–03